AIRLANGGA SCORING SYSTEM FOR PREDICTION OF DEHYDRATION IN DIARRHEAL PATIENTS

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Abstract. To investigate the predictive factors for dehydration in acute diarrheal patients, this case control study was conducted using the observational analytic method. Acute diarrheal patients who were admitted to the Hospital and Outpatient Pediatric Clinic, Dr Soetomo Hospital, were included in this study. By discriminant analysis, three significant variables were determined to differentiate dehydration risk in acute diarrheal patients: frequency of stool, amount of feces in the stool, and severity of vomiting (power test: 70.0%). Significant differences were found between the groups with and without dehydration for stool frequency each day ($p < 0.05$), amount of stool per day ($p < 0.05$), and severity of vomiting ($p < 0.05$). Frequency of stool, amount of stool, and severity of vomiting are predictive factors for dehydration in acute diarrhea.

INTRODUCTION

The most frequent episodes of diarrhea occur in the first two years of life and the highest incidence occurs between the ages of 6-11 months. This is a time when additional food is given. About 80% of the deaths caused by diarrhea occur in children less than two years of age (Bern *et al,* 1992).

At the Pediatric Department of Dr Soetomo Hospital, in the year 2000, the total number of children presenting with diarrhea was 5,685. Of those, 1,160 were hospitalized, including 227 (19.56%), 668 (57.59%), and 116 (10%) with mild, moderate and severe dehydration, respectively. Thirty-five (3.01%) died. In the United States, most dehydration is caused by acute diarrhea, with a death rate among children less than 2 years of age of 0.75% (Le Baron *et al*, 1990). Bhutta *et al* (1997), in Calcutta, reported that of all diarrheal child deaths around 2% were related to dehydration.

The most frequent cause for the high mortality and morbidity rate of patients with acute diarrhea is poor anticipatory care of the patient before dehydration has set in. It is very important to know, in the early stage of diarrheal disease, the development of dehydration as a consequence of losing water and electrolytes (Victora *et al,* 1990; Duggan *et al,* 1996; Zodpey *et al*, 1998; 1999).

The purpose of this study was to analyze clinical signs and symptoms that might be used as predictors of dehydration in children aged 1-24 months with acute diarrhea, *ie* frequency of stool, consistency of stool, amount of stool, presence of blood in the stool, mucous appearance in the stool, frequency of vomiting, duration of vomiting, severity of vomiting, amount of vomitus, pyrexia, tympanites, thirst and appetite.

MATERIALS AND METHODS

Patients

Immediately after the patients attended the Pediatric Ward or the Pediatric Outpatient Clinic of Dr Soetomo Hospital, informed consent was prepared for parental signature, permitting the patient to participate in the study. Patients who fulfilled the inclusion criteria, *ie* those with acute diarrhea and dehydration hospitalized in the Pediatric Ward, comprised the case group, while patients with acute diarrhea without dehydration in the Pediatric Outpatient Clinic of Dr Soetomo Hospital comprised the control group. The ages of the patients ranged from 1-24 months. Diar-

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rhea was defined as a watery stool with a fre-quency of 3 times or more, with the onset of diar-rhea before hospitalization of 3 days or less. The exclusion criteria included underlying disease, encephalopathy, severe malnutrition, and cases where it was unclear who was caring for and nurs-ing the patient.

Both groups were matched for age and on-set of diarrhea. The case group consisted of 25 patients, with an equal number of patients in the control group. Basic patient data consisted of identity, age, sex, address and name of parent. The primary required data were related to signs and symptoms of diarrhea: frequency of stool, consistency of stool, amount of stool, presence of blood in the stool, mucous appearance in the stool, frequency of vomiting, duration of vomit-ing, severity of vomiting, amount of vomitus, pyrexia, tympanites, thirst and appetite. Other important signs of dehydration, which occurred at home, included restlessness, reduced con-sciousness, sunken eyes, more than 6 hours with-out urine output and thirst. These indicated that dehydration had already developed at home.

Appropriate physical examinations were conducted at the time of admission and in the Outpatient Clinic. The control group was fol-lowed for a 2-day period, to evaluate the poten-tial development of dehydration or significant im-provement.

Statistical analysis

Statistical methods were used to analyze the data. The chi-square test was used to compare the two groups for nominal scale data. The two freedom sample's *t* test was used for interval scale

or ratio scale data. Discriminant function analy-sis was used to identify which factors had a strong correlation with the dependent variable and to predict the independent variable, which was in-cluded as the factor's group (Harun *et al,* 1995; Munro, 1986).

RESULTS

The average frequency of stool on the day of acute onset of diarrhea was 2-3 times/day for the group with dehydration and 1-2 times/day for the group without dehydration (Table 1). Signs and symptoms as predictors of dehydration were shown in Table 2. The characteristics of the stool factors were frequency of stool, consistency of stool, amount of stool, presence of blood in stool, mucous appearance in stool. The vomiting fac-tors were frequency of vomiting, duration of vom-iting, severity of vomiting, and amount of vomi-tus. Clinical factors were pyrexia, tympanites, thirst, and appetite. The results of statistical analy-sis for the three factors are shown in Table 3

The factors were composites of many vari-ables. The characteristics of the stool factors, vomiting factors and clinical factors, between the dehydration group and the non-dehydration group, were significantly different. After dis-criminant analysis, 3 variables were found to be significantly different to the occurrence of dehy-dration in acute diarrhea: frequency of stool, the amount of stool and the severity of vomiting (power of test = 70.0%). From these data, a pre-dictive score may be derived for dehydration in children aged 1-24 months with acute diarrhea for less than 3 days (Table 4).

Table 1
Distribution of average stool frequency per day in acute diarrhea at the Pediatric Department, Dr Soetomo Hospital, Surabaya, March-May 2001.

Frequency of stool	Dehydration n (%)	No dehydration n (%)	Total n (%)
1-4 times/day	3 (15.8)	16 (84.2)	19 (38.0)
5-7 times/day	6 (42.9)	8 (57.1)	14 (28.0)
8-10 times/day	8 (88.9)	1 (11.1)	9 (18.0)
>10 times/day	8 (100.0)	-	8 (16.0)
Total	25 (50.0)	25 (50.0)	50 (100.0)

Two freedom sample's *t* test   t = 6,107; df = 48; p = 0.001 (significant).

Table 2
Signs and symptoms as predictors of dehydration.

Variables	Chi-square			
	χ^2	df	p	
Consistency of stool	3.767	2	0.152	NS
Amount of stool	13.466	2	0.001	S
Presence of blood in stool	0.001	1	1.000	NS
Mucous appearance in stool	0.082	1	0.774	NS
Frequency of vomiting	21.667	2	0.001	S
Duration of vomiting	21.939	4	0.001	S
Severity of vomiting	21.930	2	0.001	S
Vomitus	20.667	2	0.001	S
Pyrexia	9.441	1	0.002	S
Tympanites	11.538	1	0.001	S
Thirst	15.789	1	0.001	S
Appetite	6.650	1	0.010	S

NS : Not significant   S : Significant

Table 3
Result of two freedom sample's *t* test of 'characteristics of stool factors', 'vomiting factors' and 'clinical factors' in dehydration.

Variables	Two freedom sample's *t* test		
	t	df	p
Characteristics of stool factors	9,950	48	0.001
Clinical factors	5,989	48	0.001
Vomiting factors	5,838	48	0.001

Table 4
Predictive score for dehydration in acute diarrhea.

Symptoms	Value	
Frequency of stool	≤ 7x/day = 1	≥ 8x/day = 2
Amount of stool	few = 1	moderate –large = 2
Severity of vomiting	no vomiting = 1	mild – moderate = 2

The score is calculated as follows:

Amount of stool: small = < 5 ml/kg body weight/hour

moderate = 5-15 ml/kg body weight/hour

large = > 15 ml/kg body weight/hour

Severity of vomiting: mild = after vomiting, the patient can drink well

moderate = after vomiting, the patient can drink a little

large = after vomiting, the patient cannot drink at all

The sum of the score for each variable comprises the total score, with a minimum total score of 3 and a maximum of 6.

If the score value ≥ 4, it was predicted that the patient would develop dehydration.

DISCUSSION

Analysis of average stool frequency showed a significant difference between the groups with and without dehydration ($p<0.05$). Average frequency of stool on the day of acute onset of diarrhea was 2-3 times/day for the group with dehydration and 1-2 times/day for the group without dehydration (Table 1). In this study, acute diarrheal patients with a stool frequency of 8 times/day or more developed dehydration; more frequent stool output and the development of watery stool could predict dehydration. This finding is supported by Bhattacharya et al (1995) and Zodpey et al (1998), who found that if stool frequency is 8 times/day or more, there is a risk of dehydration. Zodpey et al (1999) also reported that a stool frequency of 8 times/day is a predictor for moderate or severe dehydration. In addition, Victora et al (1990) noted that a stool frequency of more than 6 times/day is a predictor for dehydration. These two reports did not consider the amount of stool output, the severity of vomiting, or the amount of vomitus. The current study indicates that these variables are also important for predicting dehydration. Bhutta et al (1997) stated that a stool frequency of more than 12 times/day is a risk factor for death in children with persistent diarrhea. Deivanayagam et al (1993) maintained that a stool frequency of more than 10 times/day is a risk factor for persistent diarrhea. In the current study, consistency of stool, presence of blood in the stool, mucous appearance in the stool, were not found to be significant because the consistency of the stool correlates with the mechanism of diarrhea, while blood and mucus in the stool are related to the possible causes of the acute diarrhea (Cohen, 1996; Soeparto, et al, 1999; Ulshen, 2000).

In this study, an amount of watery stool output of more than 5 ml/kg body weight/hour in patients with acute diarrhea is a risk factor for dehydration.

Vomiting, as the first symptom, usually disappears within 24-48 hours, and is followed by diarrhea (Riedel, 1996; Soeparto et al, 1999; Ulshen, 2000). In this study, 48% of patients with acute diarrhea did not experience vomiting. Other studies have found that a vomiting frequency of more than 2 times/day is a risk factor for dehydration (Zodpey et al, 1998; Bhattacharya et al, 1995).

Victora et al (1990) also found that vomiting is predictive of dehydration. Zodpey et al (1999) reported that a vomiting frequency of more than 2 times/day is predictive of moderate or severe dehydration. Most of the patients (96.0%) in the dehydration group had fever. A body temperature over 37.2ºC is a risk factor for dehydration (Victora et al, 1990; Bhattacharya et al, 1995; Zodpey et al, 1998; 1999).

After discriminant analysis, 3 variables emerged as significantly different determinant factors for the occurrence of dehydration in acute diarrhea: frequency of stool, amount of stool output and severity of vomiting (power of test = 70.0%). These data can be used to assemble a predictive score for dehydration in children aged 1-24 months with acute diarrhea for less than 3 days (Table 4). The value of each variable is defined arbitrarily as 1 and 2, while the sum of each variable comprises the total score. The minimum total score was 3 and the maximum was 6. For instance, a score of ≥ 4 can predict dehydration. Based on the data from this study and appropriate statistical analysis, this scoring system can predict dehydration in acute diarrheal patients in the age range 1-24 months, with an onset of diarrhea less than 3 days. This scoring system is an essential tool for predicting dehydration in diarrheal patients. If the diarrheal patient has score more than 4 and especially 6, the patient is advised to go to hospital to receive appropriate rehydration therapy via intravenous fluid drip. This simple scoring system should be made widely available to parents, especially mothers, paramedics and medical doctors. Using this simple scoring method, the mother at home can be expected to manage diarrheal disease and evaluate its course. A progressing or increasing score, especially 6, can predict that a patient will suffer dehydration. If the score is less than 3, it is still

possible to manage the patient at home by intensive administration of oral rehydration solution. Successful application of this scoring system, especially by mothers, will prevent severe dehydration developing, with expected reductions in mortality of diarrheal patients. This score can be used in the oral rehydration area to evaluate the progress of diarrhea, and to decide whether the patient must be hospitalized or may be discharged.

Conclusion

Frequency of stool, amount of stool, and severity of vomiting are predictive factors for dehydration in acute diarrhea in children aged 1-24 months, with an onset of diarrhea of less than 3 days.

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